WJEC (Wales) Biology GCSE

Topic 1.3: Digestion and the Digestive System

Notes

Digestion

The need for digestion

Biological molecules are important in organisms to build structures and for use in metabolic reactions. Large molecules are made when many smaller molecules join together. The main biological molecules are:

- Fats - made up of glycerol and fatty acids.
- Carbohydrates - made up of simple sugars e.g. starch is made from glucose molecules.
- Proteins - made up of amino acids.

Digestion is the breakdown of large insoluble molecules of food into smaller soluble molecules. This is important because:

- Large molecules are too big to be absorbed across the surface of the gut wall.
- Ensures food molecules are soluble so that they can be transported in the bloodstream.

The smaller, soluble molecules can then be used to resynthesise larger molecules or used in cellular reactions e.g. glucose used in respiration, amino acids used to form proteins.

Digestive enzymes

The breakdown of food molecules is catalysed by a range of digestive enzymes. There are three main types of enzyme:

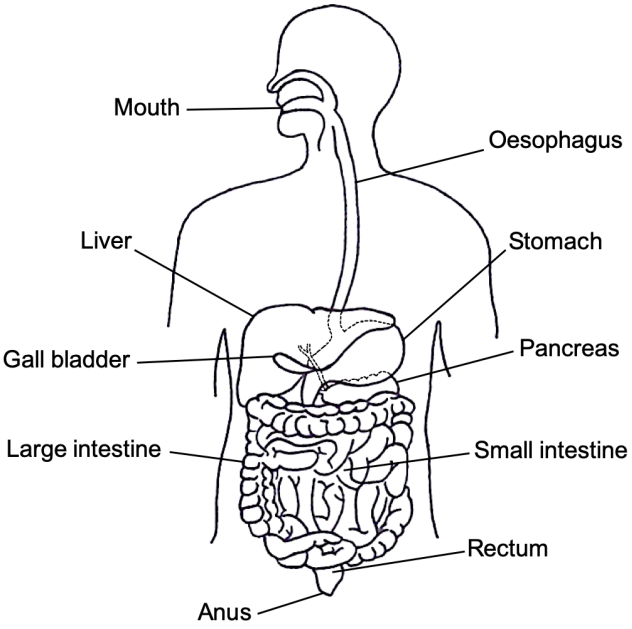
Enzyme	Function	Location
Carbohydrases	Catalyse the breakdown of carbohydrates into simple sugars	Mouth, pancreas, small intestine
Proteases	Catalyse the breakdown of proteins into amino acids	Stomach, small intestine
Lipases	Catalyse the breakdown of fats into glycerol and fatty acids	Pancreas, small intestine

The digestive system

The digestive system consists of the digestive tract and associated organs.

Three processes take place in the digestive system: digestion, absorption and egestion.

Structure of the digestive system



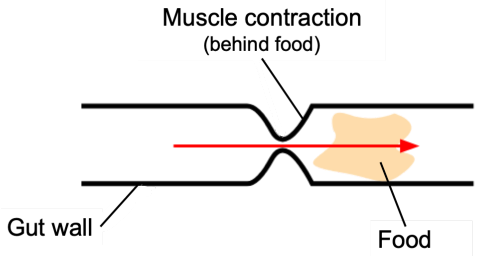
Each organ in the digestive system is specialised for a particular function. The roles of some digestive organs are outlined below:

Structure	Function
Mouth	• Food chewed and broken into smaller pieces - mechanical digestion • Amylase in the saliva breaks down starch into maltose
Stomach	• Secretes protease which breaks down proteins • Contains hydrochloric acid which kills any bacteria present in food
Pancreas	• Secretes carbohydrase and lipase (transported to small intestine)
Small intestine	• Completes digestion: - Carbohydrases break down carbohydrates - Proteases break down proteins - Lipases break down lipids • Food molecules are absorbed into the bloodstream
Large intestine	• Reabsorbs water into the bloodstream

Liver	• Produces bile
Gall bladder	• Stores bile prior to its release into small intestine
Rectum	• Stores faeces prior to egestion
Anus	• Where faeces are egested

Peristalsis

Peristalsis is the process by which food moves through the digestive system. It is a wave of muscle contractions in the gut wall which forces food down the gut.



Bile

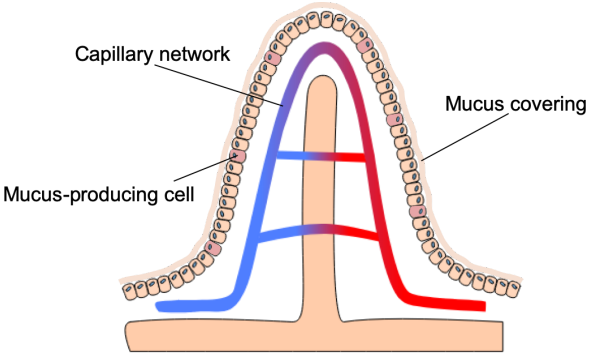
Bile (a liquid secreted by the liver) aids the digestion of lipids in the small intestine by:

- Neutralising acid from the stomach to provide optimum conditions for enzymes in the small intestine.
- Emulsifying lipids to provide a greater surface area for lipases to digest them.

Adaptations of the small intestine

The small intestine is adapted for the absorption of food molecules into the bloodstream:

- Surrounded by a network of capillaries which provide a good blood supply, maintaining a steep concentration gradient.
- Many villi in the walls of the small intestine to increase the surface area for absorption.
- Walls of villi one cell thick giving a short diffusion distance.



Model of the digestive system

Visking tubing (permeable, plastic tubing) can be used as a model of the gut. However, there are some limitations of this:

Gut	Visking tubing
Gut wall consists of living cells which can transport molecules via active transport	Non-living cells so no active transport
No pores in gut wall	Contains pores
Villi provide large surface area	Smaller surface area as no villi
Bloodstream maintains steep concentration gradient	Uses distilled water so concentration gradient is not maintained

Diet and health

The body requires a variety of nutrients to provide a balanced diet.

Nutrients	Function
Carbohydrates	• Broken into smaller sugars e.g. glucose • Sugars used in respiration to release energy or are stored
Proteins	• Broken into amino acids • Joined in long chains to form new proteins which are used for growth
Lipids	• Broken into fatty acids and glycerol • Fatty acids and glycerol used as an energy store
Minerals	• Range of different functions • e.g. iron required for the synthesis of haemoglobin in red blood cells
Vitamins	• Range of different functions • Vitamin C involved in collagen formation and working of immune system
Fibre	• Provides bulk which aids the movement of food via peristalsis
Water	• Main component of cells • Enables chemical reactions to take place within cells • Transport medium for glucose, minerals etc.

Different foods have varying energy contents. Lipids release the greatest amount of energy per gram. When energy intake from food is in excess, they are stored as fat beneath the skin and surrounding organs.

There are various health implications associated with an excess of sugar, fat and salt in an individual's diet.

Diet high in...	Implications
Sugar	Increased risk of obesity, type 2 diabetes, tooth decay
Salt	Increased risk of high blood pressure, cardiovascular disease
Fat	Increased risk of obesity, cardiovascular disease, type 2 diabetes, cancer

Food tests

Food	**Test**	**Positive Result**
Glucose	Add an equal volume of test solution and Benedict's reagent to a boiling tube. Heat in a boiling water bath for five minutes. Remove the boiling tube and observe the colour of the precipitate formed.	Colour change from green to yellow to orange to brown to brick red depending on the quantity of glucose present.
Protein	Add an equal volume of test solution and Biuret reagent to a boiling tube. Shake gently to mix. Observe colour change.	Colour change from pale blue to purple
Starch	Add some test solution to a test tube. Add two drops of iodine solution, gently mix. Observe colour change.	Colour change from yellow-brown to blue-black